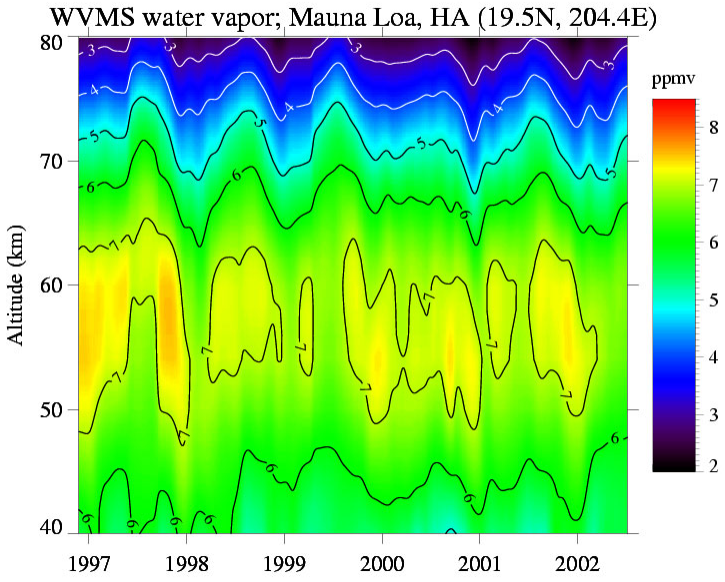
WVMS: Measuring Water Vapor in the Middle Atmosphere

Water vapor measurements in the middle atmosphere are important for several reasons. First, water vapor is the primary source of the OH radical and other hydrogen compounds, and is therefore important in ozone chemistry. In addition, water vapor entering the stratosphere is extremely sensitive to temperatures at the tropical tropopause, and is therefore relevant to our understanding of how and where air rises from the troposphere into the stratosphere. Finally, because water vapor is an important greenhouse gas, the amount of water vapor in the atmosphere is extremely relevant to the global warming problem.

The Water Vapor Millimeter-wave Spectrometer (WVMS) instruments make spectral measurements near 22 GHz, and thereby provide measurements of the water vapor profile from 40 to 80 km. The goal of this project is to provide the first continuous record of water vapor in the middle atmosphere using ground based radiometers. All of the instruments have provided nearly continuous data records during their period of operation. We have measurements from Table Mountain, California (May 1993 to November 1997) from Lauder, New Zealand (November 1992 to May 1993, and from January 1994 to the present) and from Mauna Loa, Hawaii (March 1996 to the present). The instruments are all operated remotely from the Naval Research Laboratory, with calibration and emergency support provided by on-site staff.



The instruments are installed at sites of the international Network for the Detection of Stratospheric Change (NDSC). The NDSC is a set of high-quality remote-sounding research stations for observing and understanding the physical and chemical state of the stratosphere. The WVMS instruments provide the sole source of middle atmospheric water vapor data from these sites.

WVMS measurements have appeared in 10 peer-reviewed publications as well as in several World Meteorological Organization (WMO) reports. The measurements played an important role in documenting the large increase (~2%/year) in middle atmospheric water vapor that was observed in the early 1990s. The observed increase is thought to be related to the eruption of Mount Pinatubo in 1991, but the precise mechanism which caused the increase is still not understood. In addition to the increase in the early 1990s, there are other measurements which suggest that there is a longer term ~1%/year increase in middle atmospheric water vapor that dates back to the 1950s. While some of this long-term increase can be attributed to the effects of global increases in methane on water vapor, the observed increase is too large to be attributed entirely to this mechanism. The magnitude of the observed increases in middle atmospheric water vapor, the difficulty of pinpointing the causes of these increases, and the importance of such increases to ozone chemistry and global warming, all highlight the importance of maintaining these continuous measurements.

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